Staff Analysis of Proposed Early Action for Climate Change Mitigation in California

1. Early Actions Strategy Name and Proponent

SUMMARY # *C19*
ID NUMBER: *ARB 2-5*
TITLE: *FOAM RECOVERY/DESTRUCTION PROGRAM*
PROPONENT: *AIR RESOURCES BOARD STAFF*

2. Staff Recommendation

This measure was approved by the Board as an early action at its June 2007 hearing. Based on further evaluation by staff, no change in the classification of this measure is recommended. The Board date for consideration of this item is anticipated in 4th quarter of 2011.

This timing will allow staff the time to complete inventory research[1], interagency coordination, economic analyses, staff reports, stakeholder workshops, and public hearings to support the necessary regulation(s).

An alternative or complimentary approach may include establishing a voluntary agreement for recovery and destruction for certain foams, if the agreement can be implemented more cost-effectively and can be expected to yield similar CO_2E benefits as mandatory compliance.

3. Early Action Description

This strategy involves a regulatory measure(s) to implement a program to recover and destroy high-GWP insulating foams from buildings, other construction/demolition (C/D) waste, and appliances at end-of-life (EOL). The appliance foam recovery would be coordinated with the US EPA, as they have implemented a similar, voluntary program with some utility providers[2].

Many foams contain high-GWP GHG blowing agents, especially older insulating foams used in appliances and buildings, that contain chlorofluorocarbon (CFC) blowing agents such as CFC-11 (100-year direct GWP of 4,600).

Currently, foams are either broken (building panels) or shredded (appliances) and landfilled; at this time, no federal or state laws require that foams containing ozone

[1] Inventory work in this area is expected to be complete by late 2009.
[2] Responsible Appliance Disposal program, or RAD: http://www.epa.gov/ozone/snap/emissions/radp.html

depleting substance (ODS) or other high-GWP blowing agents in the foam be removed and destroyed[3].

Foam recovery from appliances may either be done manually, or as part of a fully automated recovery system in which appliance refrigerant is removed/de-gassed, the appliance is shredded, with the refrigerant in the foam collected from the gaseous and solid phases and subsequently destroyed.

4. Potential Emission Reductions

Estimated annual emission reductions of 0.9 $MMTCO_2E$ are currently possible for residential refrigerator and freezer foam recovery[4]. This number may be offset somewhat by CO_2 emissions associated with foam destruction[5]. Of the 0.9 $MMTCO_2E$, 0.8 $MMTCO_2E$ is due to recovery of foam containing R-11.

The CO_2E emission reductions are calculated for 2005 with only refrigerators and freezers considered since quantities of insulating foams recovered from A/Cs and building wastes annually in California are unknown. Without knowledge of the numbers and age distributions of appliances in California, 2020 emissions reductions based on sector growth and transitional blowing agent use estimates were not possible. However, it is reasonable to assume that approximately 0.9 $MMTCO_2E$ reductions will be possible every year until refrigerators and freezers containing R-11 are gone.

To summarize, by about 2012 annual emissions reductions of **0.9 $MMTCO_2E$** may be possible by recovering foams banked in old refrigerators and freezers that would otherwise go to landfills. Emissions benefits associated with foam recovery from building and additional C/D wastes could not be estimated.

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[3] Although refrigerant removal is required at appliance EOL under federal and state law, it is unknown at this time whether foam and refrigerant recovery would be performed by the same people at the same time; the process and technician certification requirements are expected to differ.

[4] The following assumptions were used: 1) 20 year lifetimes for refrigerators, 2) R-11 use in refrigerators stopped in 1995; from 1995 – 2005 HCFC-141b was used, 3) in 2005, half of disposed refrigerators contain R-11 as the foam blowing agent and the other half contain 141b, 4) 25% of the foam blowing agent is lost into the cabinet and is released into the atmosphere and that the remaining 75% is recoverable, 5) 13,000,000 refrigerator/freezers are disposed of annually in the US and 60% go to landfills or transfer stations 6) the California population fraction was roughly 13% in 2005, 7) 100-year direct GWPs of 4600 and 700 were used for R-11 and HCFC-141b, respectively, 8) blowing agent masses of 0.45 kg/appliance and 0.38 kg/appliance for R-11 and HCFC-141b, respectively, were obtained from USEPA (Dave Godwin, personal conversation, 2/07).

[5] An additional 0.8 MMT CO2E should be avoided at appliance EOL, as refrigerant recovery is mandated by federal and state law; this is discussed in the following strategy, ARB 4-2. Foam destruction would require a large amount of additional analysis; currently, USEPA is developing a plan to destroy ODSs at RCRA facilities, and the operating assumption is that the CO2 emissions associated with relatively small amounts of foams and refrigerants are small compared to the hazardous waste destruction throughput of a typical RCRA facility, but this supposition is subject to further analysis and change.

5. Estimated Costs/Economic Impacts and the Impacted Sectors/Entities

The US EPA estimates that automated foam recovery at appliance EOL costs approximately **$6.5/TCO$_2$E**, while manual foam recovery at appliance EOL costs approximately **$48/TCO$_2$E**. The US EPA states that foam recovery from steel faced building panels is cost effective where large volumes of panels are in one place[6].

The impacted sectors and entities would mostly be appliance salvagers/recyclers and possibly individuals disposing of foam-containing appliances, as recovery costs are expected to be passed along to the user. Recovery of foam from buildings is not currently performed.

A foam recovery program for appliances is currently operating as an incentive program between the US EPA and utility companies, some of which are located in California (Responsible Appliance Disposal program, or RAD, see following strategy, ARB 4-2). The program was started in 2006 and the success of the program has not been gauged yet, although it is anticipated that a mandatory program would be more effective.

6. Technical Feasibility

The technology required to remove foam blowing agents from appliances and other construction and demolition wastes is feasible, but labor intensive if manual removal is employed. Automated foam removal from appliances is technically feasible, and can be performed during scrap metal processing and recovery.

7. Additional Considerations

Ozone depleting substances (ODSs) were used in the past as foam-blowing agents; CFC-11 (100-year direct GWP of 4,600) was used for many years, and phaseout of its replacement, HCFC-141b (100-year direct GWP of 700), from appliance foam has only been occurring in the past four years. Recovering and destroying ODSs may be a cost-effective way to reduce high-GWP gas emissions, and also reduces negative impacts on stratospheric ozone.

It is also possible that special facilities will need to be constructed if automated foam removal is deemed more economically feasible than manual foam removal and would therefore need to be considered in any estimates of cost-effectiveness.

The impacted sectors and entities would mostly be appliance salvagers/recyclers and possibly individuals disposing of foam-containing appliances, as recovery costs are expected to be passed along to the user. California trade associations associated with recycling of scrap metals are unknown. Coordination with the US EPA with respect to this regulation is ongoing.

Comments Received From: DuPont Company.

[6] USEPA, Draft Proposed Measures Arising from the IPCC/TEAP Special Report & its Supplement, by End-Use, Expert Workshop on IPCC/TEAP Special Report, July 2006.

8. Division: Research Division
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9. References

Arthur D. Little, Inc., Global Comparative Analysis of HFC and Alternative Technologies for Refrigeration, Air Conditioning, Foam, Solvent, Aerosol Propellant, and Fire Protection Applications, Final Report to the Alliance for Responsible Atmospheric Policy, March 21, 2002.

David Godwin (USEPA), Marian Martin Van Pelt and Katrin Peterson (ICF Consulting), Modeling Emissions of High Global Warming Potential Gases from Ozone Depleting Substance Substitutes, 2003.

IPCC/TEAP, IPCC Special Report on Safeguarding the Ozone Layer and the Global Climate System, Issues related to Hydrofluorocarbons and Perfluorocarbons, 2005.

SEPA, Guidance on the Recovery and Disposal of Controlled Substances Contained in Refrigerators and Freezers, 2002: http://www.sepa.org.uk/pdf/consultation/closed/2003/fridge/fridge_consultation.pdf

USEPA, Draft Proposed Measures Arising from the IPCC/TEAP Special Report & its Supplement, by End-Use, Expert Workshop on IPCC/TEAP Special Report, July 2006.

USEPA, RAD program website: http://www.epa.gov/ozone/snap/emissions/radp.html